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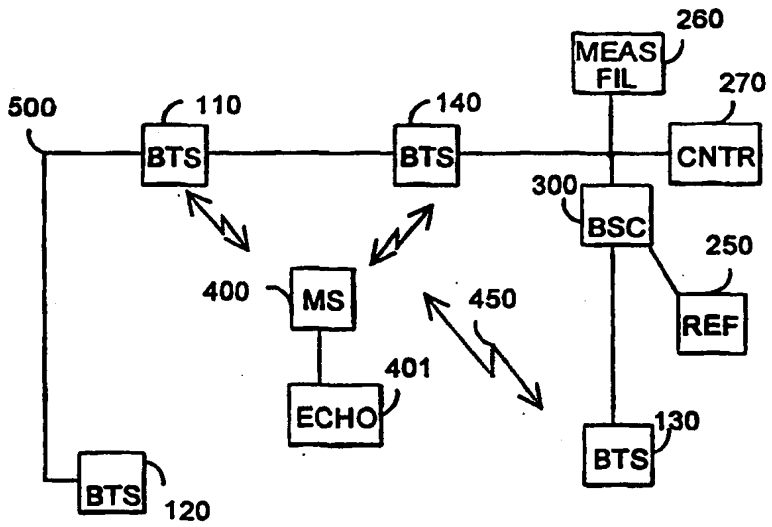

(57) Abstract

The invention relates to a data transmission method and a radio system comprising a number of transceivers (110, 120, 130, 140) and at least one subscriber terminal (400) which transmits a number of access bursts on its traffic channel during handover. In the radio system, a connection between a transceiver and a subscriber terminal is set up when the transceiver receives from its random access channel an access burst transmitted by the subscriber terminal (400), the reception of said access burst activating the allocation of a channel used for the connection. The radio system comprises means (260) for measuring the bursts received by the transceiver from the random access channel, means (250) for generating a handover reference signal which deviates from the bit pattern of the random access burst and which is transmitted to the treansceiver during handover, whereupon it is possible for the means (260) to filter off the handover reference signal received in order to prevent the allocation of a channel.

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DATA TRANSMISSION METHOD AND RADIO SYSTEM

FIELD OF THE INVENTION

The invention relates to a data transmission method to be used during handover in a radio system comprising a number of transceivers and at least one subscriber terminal which transmits a number of access bursts on its traffic channel during handover, and in which radio system a connection between a transceiver and a subscriber terminal is set up when the transceiver receives from its random access channel an access burst transmitted by the subscriber terminal, the reception of said access burst activating the allocation of a channel to be used for the connection.

The invention further relates to a radio system comprising a number of transceivers and at least one subscriber terminal which transmits a number of access bursts on its traffic channel during handover, and in which radio system a connection between a transceiver and a subscriber terminal is set up when the transceiver receives from its random access channel an access burst transmitted by the subscriber terminal, the reception of said access burst activating the allocation of a channel to be used for the connection.

DESCRIPTION OF THE PRIOR ART

A special random access channel (RACH) is used in radio systems for setting up a connection between a terminal and a base station. When the terminals desire to set up a radio connection, they send a message of setting up the connection, in other words a random access burst, to the base station which forwards it to the system in which resources are allocated for the connection. This means that a particular time slot which enables the connection setup message to be sent by the terminals to the base station is allocated for the message. The system can by no means know when the terminals desire to communicate, so the first message of the terminal to the base station can not be coordinated. The terminals also lack information about the length of the propagation delay of the signal, thus the messages are randomly supplied within a given time slot.

In a typical cellular radio system, the subscriber terminal communicates with only one base station at a time, although particularly in the CDMA system, for example, the subscriber terminal can also communicate with several base stations simultaneously. When the terminal moves in the area of the

cellular radio system, it becomes necessary to perform a handover from time to time.

In a known, soft handover the connection to the base station network remains uninterrupted regardless of the handover. The base station is typically changed in this kind of handover. A softer handover where the base station is not changed but the sector of the base station used is changed is also known.

A hard handover, which is a break-before-make-type handover, is also used in cellular radio systems. This means that a new connection from the subscriber terminal to the base station will not be set up until the previous base station connection has been interrupted. Although the radio system has been designed to operate on soft and softer handover, there are several reasons for performing the hard handover in cellular radio systems. These reasons include a need to modify the connection parameters, the frequency channel used, the radio system, etc.

During handover, the target base station participating in the handover receives handover access bursts transmitted by the subscriber terminal. The subscriber terminal transmits the handover access bursts on a traffic channel (TCH). After the transmission of the handover access bursts the subscriber terminal sends an acknowledgement of the successful handover.

When a subscriber terminal sets up a connection to a base station it transmits access bursts to the base station. The base station receives the access bursts from its random access channel, i.e. RACH channel. After the reception of the access bursts the base station controller controlling the base station in the radio system transmits a channel-activating signal to the base station. In practice, the access bursts used for performing a handover and setting up a speech connection are similar as far as the base station receiver is concerned.

An access burst transmitted during handover can sometimes be forwarded to a base station which is not involved in the handover. If the base station which is not involved in the handover receives from its RACH channel a burst which was originally transmitted to the traffic channel of another base station by the subscriber terminal, the base station system allocates a channel unnecessarily. In handover, the subscriber terminal generally transmits several access bursts which can, disadvantageously, allocate all channels from the

base station which is not involved in the handover. The unnecessary channel allocations reduce the capacity available for the radio system.

Insufficient network planning is the main reason why a base station receives a signal which is not originally intended to the base station. In practice, however, it is not possible to plan a radio network in such a manner that all the above problems could be eliminated. It is increasingly difficult to take account of said problems in advance in network planning, since network planning is constantly becoming more complex. In practice, it is not possible to prevent all unnecessary channel allocations by means of network planning.

FI 100077 B discloses a mobile communication system in which a mobile station and a base station measure the power of a received signal, whereupon it is possible for the base station to use the measurement results to decide whether to change base stations. This publication does not, however, disclose any criterion by which it would be possible to perform a filtering. The described solution is, however, used for deciding whether to change base stations and not for preventing channel allocation.

EP 0615392 A1 discloses a method in which the parameters located in a signal transmitted between a base station and a mobile station are measured. The measurement results obtained can be used to decide whether to change base stations. The solution disclosed in the publication is not, however, suitable for filtering unnecessary channel allocation requests.

DE 19510256 A1 discloses a method in which the parameters located in a signal transmitted between a base station and a mobile station are measured and the values of the parameters are compared with threshold values. The method seems to be suitable for deciding whether to change base stations and not for filtering channel allocation requests.

WO 97/15169 discloses a method in which the time slots of the received signals are measured. The measurement results are, however, used to decide whether to change base stations and not for filtering channel allocation requests.

WO 95/22876 discloses a method in which time slots are measured and in which some parameters are picked from the measurement results obtained. The method is, however, used in handover and not for filtering channel allocation requests.

FI 934731, GB 2280335 A, GB 296628 A and WO 96/166524 A3 each discloses a method in which time slots are measured and in which some

parameters are picked from the measurement results obtained. The methods are, however, used in handover and not for filtering channel allocation requests.

BRIEF DESCRIPTION OF THE INVENTION

An object of the present invention is thus to prevent a radio system from each time allocating a channel on the basis of a signal received even though a base station receives a signal which activates the allocation of a channel.

This is achieved with the data transmission method of the type described in the introduction, the method being characterized in that bursts received from the random access channel by the transceiver are measured, a handover reference signal which deviates from the random access burst is transmitted to the transceiver during handover, and the received handover reference signal is filtered off on the basis of a measurement, whereby the allocation of a channel can be prevented.

This can be achieved with the radio system of the invention, which is characterized in that the radio system comprises means for measuring the bursts received from the random access channel by the transceiver, means for generating a handover reference signal which deviates from the bit pattern of the random access burst and which is transmitted to the transceiver during handover, whereupon it is possible for the means to filter off the handover reference signal they received in order to prevent the allocation of a channel.

Considerable advantages can be achieved by the data transmission method of the invention. The method enables optimum channel allocation in a radio system, whereby unnecessary channel allocations can be avoided. Since it is possible to restrict channel allocations, the radio system can serve subscriber terminals attempting to set up a connection faster and in a more flexible way. The method is extremely well suited for radio systems where there are many connections and many handovers occur in relation to the channel capacity of the radio system.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in closer detail in the following with reference to the examples in accordance with the accompanying drawings, in which

Figure 1 shows a radio system in which the method of the invention is used

Figure 2 is a signal flow diagram of a connection setup,

Figure 3 shows an access burst,

Figure 4 is a signal flow diagram of a handover,

Figure 5 shows the radio system of the invention in closer detail.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a radio system in which the method of the invention is used. The radio system comprises base stations 110, 120, 130, 140 operating as transceivers, a base station controller 300, and at least one subscriber terminal 400. The base station controller 300 and the base stations are interconnected by a digital transmission link 500 in the solution of the figure. The base station controller 300 controls the operation of the base stations 110, 120, 130, 140.

When the subscriber terminal 400 moves from the coverage area of a base station to the coverage area of another base station, a handover is performed. The subscriber terminal 400 sets up a connection to the base station utilizing a traffic channel (TCH). In practice, one time slot forms a TCH channel.

Figure 1 shows a dotted line 10 to describe the boundary region between the base stations 110 and 140. The boundary region separates the coverage areas of the base stations from each other. At point 1 the subscriber terminal 400 communicates with the base station 110. When the subscriber terminal 400 moves on in the base station network, it arrives at point 2 where it is on the edge of the coverage areas of the base stations 110 and 140. In such a case, a handover is performed to the subscriber terminal 400, which means that the base station 110 is changed to the base station 140. At point 3 the subscriber terminal communicates only with the base station 140.

Figure 2 is a signal flow diagram of a process of setting up a connection to a base station by a subscriber terminal. The set-up connection is used, for example, for transmitting speech to another subscriber terminal. Let us assume, with reference to Figure 1, that the subscriber terminal 400 is located at point 1. Let us further assume that point 1 is located within the coverage area of the base station 110. The setup of a connection is initiated in such a manner that the subscriber terminal 400 transmits an access burst to a radio

path. The signal is received at the base station 110 since the subscriber terminal is located within the coverage area of the base station 110.

The base station 110 receives from its RACH channel the access burst transmitted by the subscriber terminal 400, which is forwarded to the base station controller 300. The base station controller 300 sends the base station 110 a channel activation command on the basis of the access burst received. Next, the base station controller 300 transmits a channel allocation command to the subscriber terminal 400 via the base station 110. The subscriber terminal 400 is commanded to use the channel that was previously allocated from the base station on the basis of the allocation command. The subscriber terminal 400 subsequently transmits an acknowledgement signal of the set-up connection to the base station controller 300.

The subscriber terminal 400 sets up the connection to the base station by the access burst it transmitted. Figure 3 shows an access burst comprising 88 bits. The burst comprises eight extended T-bits (Tail-bits). In addition, the burst comprises a synchronization sequence comprising 41 synchronization bits. The synchronization sequence operates as a training sequence. Furthermore, the burst comprises 36 bits which are allocated to data. The burst further comprises, after the data bits, three T-bits and a guard period whose length is 68.25 bits.

When the subscriber terminal 400 moves in the radio system, it becomes necessary to perform a handover at some stage. Figure 4 is a signal flow diagram showing a handover in closer detail. The handover will be described in the following in connection with Figure 1 where the subscriber terminal 400 moves from point 1 towards point 3. The handover is thus performed from the base station 110 which operates as a source base station to the base station 140. The base station 140 operates as a target base station in the situation of the figure. Let us further assume that in the initial situation the subscriber terminal 400 has already in advance set up the connection to the base station controller 300 via the base station 110.

In the above situation the base station controller 300 transmits a signal to the base station 140 which activates a channel on the basis of the signal received. Next, the base station controller 300 transmits a handover command passing via the base station 110 to the subscriber terminal 400. After receiving the handover command, the subscriber terminal transmits access bursts on its traffic channel to the base station 140 operating as the target

base station. After the handover the subscriber terminal 400 transmits an acknowledgement of the successful handover to the base station controller 300, the acknowledgement passing via the base station 140. The subscriber terminal 400 and the base station 140 use the traffic channel (TCH) in the above situation when they transmit the signals associated with the handover.

Figure 5 shows the structure of the radio system of the invention in closer detail. The radio system comprises means 401 which are operatively connected to the subscriber terminal 400. In addition, the radio system comprises means 250 which are preferably operatively connected to the base station controller 300. In the radio system of the figure, the base station controller 300 comprises the means 250. Let us assume that the subscriber terminal 400 moves towards point 2 shown in Figure 1, whereby the handover is performed as described above. The handover access bursts transmitted by the subscriber terminal 400 can, however, transfer in accordance with a signal 450 in such a manner that the base station 130 receives the bursts from its RACH channel. In the prior art radio systems, the reception of the access bursts thus causes the allocation of channels from the base station 130.

In the radio system of the figure, the means 250 generate a handover reference signal which is forwarded to the base station 110. The base station controller 300 commands the subscriber terminal 400 to perform the handover, whereupon the base station 110 transmits the handover reference signal generated by the means 250 to the subscriber terminal 400. The means 401 echo the handover reference signal received by the subscriber terminal 400 back to the radio system in the handover access burst. In the data transmission method of the invention, the means 250 select a bit pattern which deviates from the regular bit pattern of the random access burst for the reference signal used in the handover command.

The means 250 use an eight-bit signal which comprises a 01100XXX or a 0111XXXX bit pattern as the handover reference signal. The X-bits are 'don't care bits', in other words they can be given the values '0' or '1'. It is also possible to use rare bit patterns in the radio system as the bit pattern of the reference signal. It is possible to distinguish the handover access bursts and the random access bursts from each other on the basis of the bit pattern. The bit pattern of the reference signal enables the handover access bursts received from the RACH channel to be detected and to be filtered.

Although the invention has been described in the above with reference to the examples in accordance with the accompanying drawings, it will be obvious that the invention is not restricted to them but it can be modified in many ways within the scope of the inventive idea disclosed in the appended claims.

CLAIMS

1. A data transmission method to be used during handover in a radio system comprising a number of transceivers (110, 120, 130, 140) and at least one subscriber terminal (400) which transmits a number of access bursts on its traffic channel during handover, and in which radio system a connection between a transceiver and a subscriber terminal is set up when the transceiver receives from its random access channel an access burst transmitted by the subscriber terminal (400), the reception of said access burst activating the allocation of a channel to be used for the connection, **characterized** in that

bursts received from the random access channel by the transceiver are measured,

a handover reference signal which deviates from the random access burst is transmitted to the transceiver during handover, and

the received handover reference signal is filtered off on the basis of a measurement, whereby the allocation of a channel can be prevented.

2. A data transmission method as claimed in claim 1, **characterized** in that during handover, the handover reference signal which deviates from the random access burst is transmitted to the transceiver on the traffic channel, and the received handover reference signal is filtered off if the handover reference signal is received from the random access channel.

3. A data transmission method as claimed in claim 1, **characterized** in that the handover reference signal is filtered off when the base station receives the handover reference signal from the random access channel.

4. A data transmission method as claimed in claim 1, **characterized** in that the handover reference signal is transmitted to the subscriber terminal which echoes the handover reference signal received back to the transceiver.

5. A data transmission method as claimed in claim 1, **characterized** in that the handover reference signal whose bit pattern deviates from the access burst used in allocating a channel on the basis of a different bit pattern is used in the handover.

6. A data transmission method as claimed in claim 1, **characterized** in that the handover reference signal which comprises a

01100XXX or a 0111XXXX bit pattern where the X-bit is a 'don't care bit' is used in the method.

7. A data transmission method as claimed in claim 1, **characterized** in that in practice the transceiver used in the method is a base station.

8. A data transmission method as claimed in claim 1, **characterized** in that the random access channel is measured uninterruptedly.

9. A data transmission method as claimed in claim 1, **characterized** in that the signal is filtered at the base station or the base station controller in the radio system.

10. A radio system comprising a number of transceivers (110, 120, 130, 140) and at least one subscriber terminal (400) which transmits a number of access bursts on its traffic channel during handover, and in which radio system a connection between a transceiver and a subscriber terminal is set up when the transceiver receives from its random access channel an access burst transmitted by the subscriber terminal (400), the reception of said access burst activating the allocation of a channel to be used for the connection, **characterized** in that the radio system comprises

means (260) for measuring the bursts received from the random access channel by the transceiver,

means (250) for generating a handover reference signal which deviates from the bit pattern of the random access burst and which is transmitted to the transceiver during handover, whereupon it is possible for the means (260) to filter off the handover reference signal received in order to prevent the allocation of a channel.

11. A radio system as claimed in claim 10, **characterized** in that the radio system comprises the means (250) for generating the handover reference signal which deviates from the bit pattern of the random access burst and which is transmitted to the transceiver during handover, whereupon it is possible for the means (260) to filter off the handover reference signal received.

12. A radio system as claimed in claim 10, **characterized** in that during handover, the handover reference signal which deviates from the access burst is transmitted to the transceiver on the traffic channel, and the means (260) filter off the handover reference signal received if the transceiver receives the handover reference signal from its random access channel.

13. A radio system as claimed in claim 10, **characterized** in that the means (260) filter off the handover reference signal when the base station receives the handover reference signal from the random access channel.

14. A radio system as claimed in claim 10, **characterized** in that the handover reference signal is first transmitted to the subscriber terminal (400), and the radio system comprises means (401) for echoing the handover reference signal received by the subscriber terminal back to the transceiver.

15. A radio system as claimed in claim 10, **characterized** in that the bit pattern of the handover reference signal generated by the means (250) deviates from the random access burst used in allocating a channel on the basis of a different bit pattern.

16. A radio system as claimed in claim 10, **characterized** in that the handover reference signal generated by the means (250) comprises a 01100XXX or a 0111XXXX bit pattern where the X-bit is a 'don't care bit'.

17. A radio system as claimed in claim 10, **characterized** in that in practice the transceiver in the radio system is a base station.

18. A radio system as claimed in claim 10, **characterized** in that the means (260) measure the random access channel uninterruptedly.

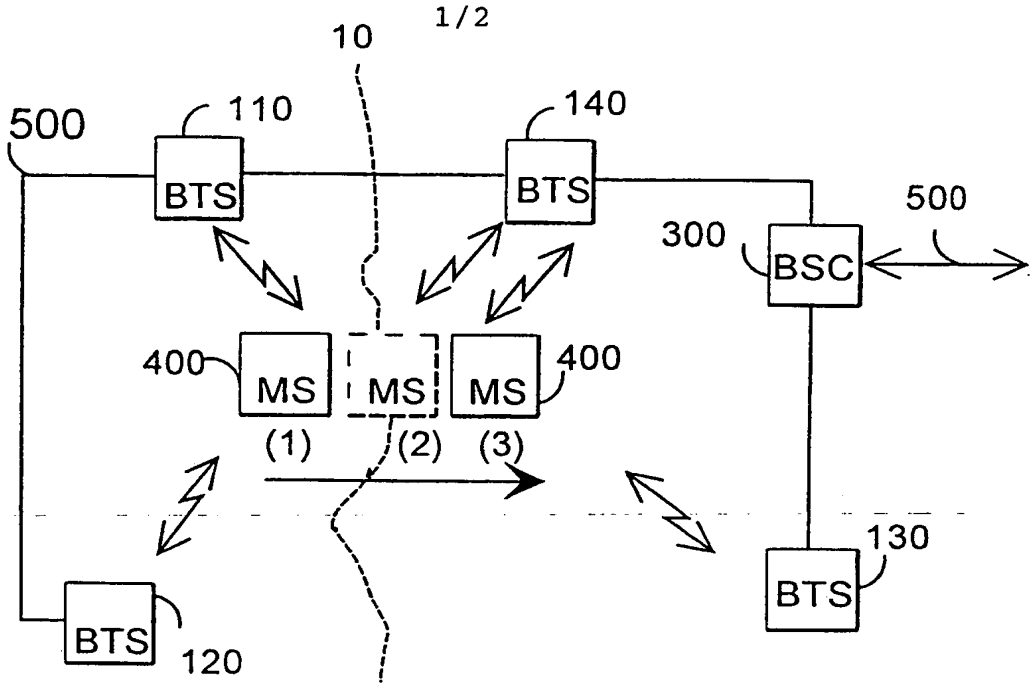

Fig.1

Fig. 3

T8	SYNC 41	DATA 36	T3	GP 68.25

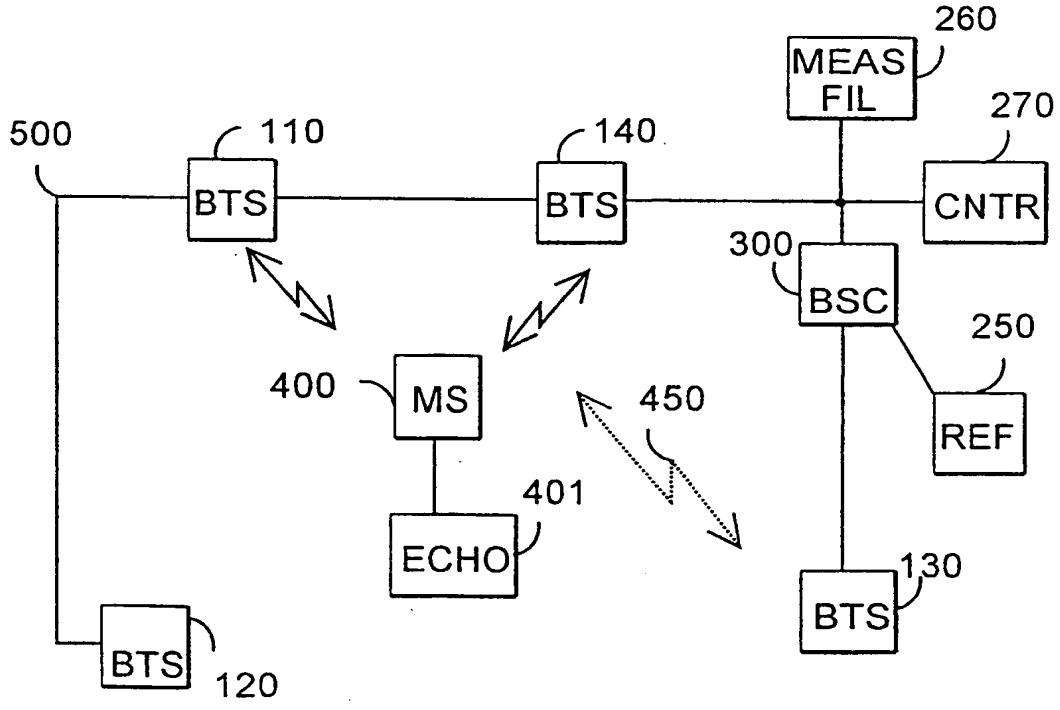

Fig. 5

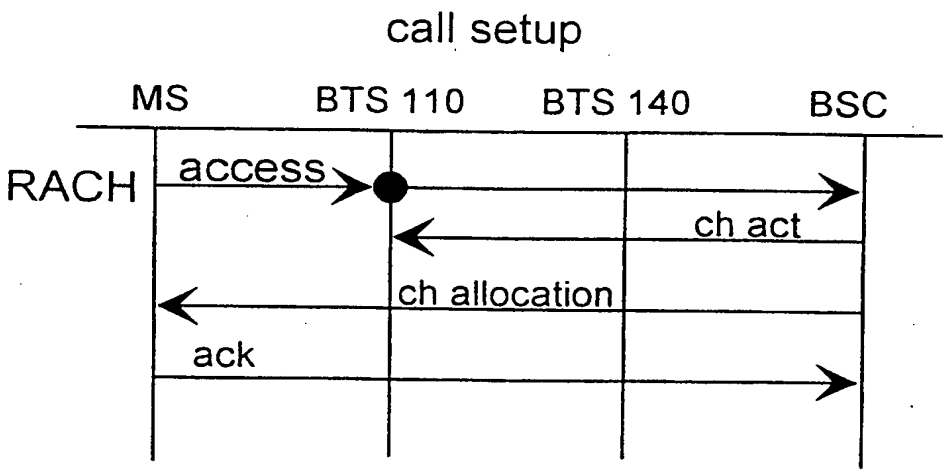

Fig. 2

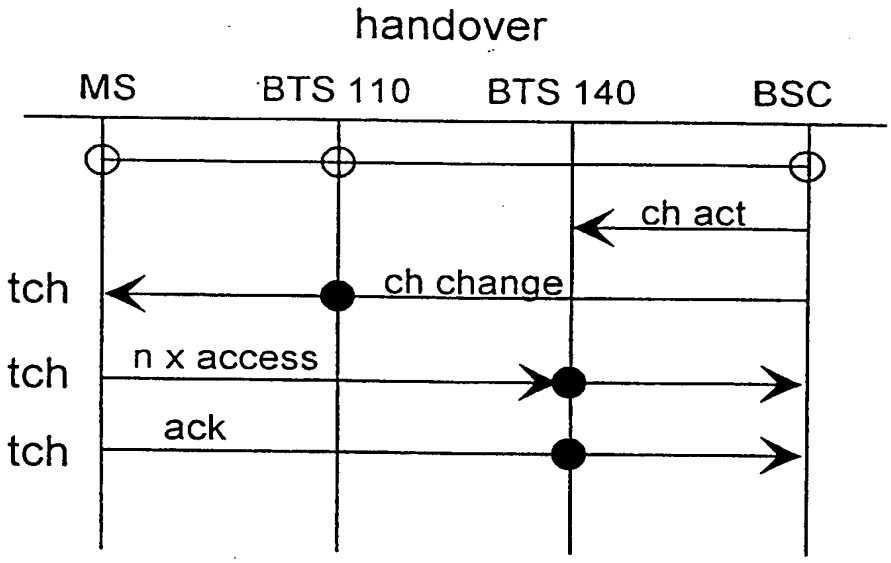

Fig. 4

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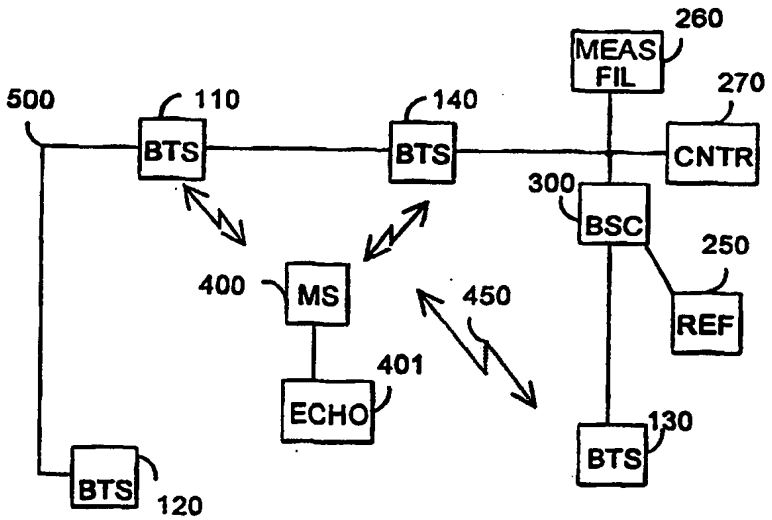

(57) Abstract

The invention relates to a data transmission method and a radio system comprising a number of transceivers (110, 120, 130, 140) and at least one subscriber terminal (400) which transmits a number of access bursts on its traffic channel during handover. In the radio system, a connection between a transceiver and a subscriber terminal is set up when the transceiver receives from its random access channel an access burst transmitted by the subscriber terminal (400), the reception of said access burst activating the allocation of a channel used for the connection. The radio system comprises means (260) for measuring the bursts received by the transceiver from the random access channel, means (250) for generating a handover reference signal which deviates from the bit pattern of the random access burst and which is transmitted to the treansceiver during handover, whereupon it is possible for the means (260) to filter off the handover reference signal received in order to prevent the allocation of a channel.

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AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
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CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
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CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
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EE	Estonia	**LR**	Liberia	**SG**	Singapore		

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00520

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/38
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4984290 A (STEPHEN N. LEVINE ET AL), 8 January 1991 (08.01.91), column 6, line 50 - column 7, line 21, claim 11	1-18
A	WO 9642143 A1 (TELEFONAKTIEBOLAGET LM ERICSSON), 27 December 1996 (27.12.96), page 2, line 22 - line 26; page 5, line 1 - line 9	2-3,9,11-13
A	EP 0448015 A2 (FUJITSU LIMITED), 25 Sept 1991 (25.09.91), abstract	8,18

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 January 1999	11 -01- 1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Per Källquist Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

Information on patent family members

01/12/98

International application No.
PCT/FI 98/00520

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